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MODIFIED BOOSTING CLASSIFICATION SYSTEM FOR HUMAN ACTION CLASSIFICATION USING 3D MODIFIED HARRIS CORNER DETECTOR

[1]P.Santhi, [2]K.Deepa
[1]*Associate Professor of CSE, M.Kumarasamy College of Engineering, Karur.*
[2]*Assistant Professor of CSE, M.Kumarasamy College of Engineering, Karur.*
E-mail:santhipalanisamypec@gmail.com

ABSTRACT

In real world most of the applications are using the data mining techniques for mining the movable or stable images. The data mining technique is mainly used in disease diagnosis, action classification, object identification, military application and etc. This paper gives the technique for action classification of real time video images. Most of the research papers are using the support vector machine (SVM) for action classification. Commonly, the SVM and Adaboost techniques are having the good performance compare to other classification techniques. But, when compared to SVM the adaboost technique having less tuning parameters to increase the performance of classification algorithm and the main disadvantage of this technique is noise sensitivity. This paper concentrates the modified adaboost technique for action classification. This technique avoids the drawbacks of existing adaboost classification technique. This technique is applied into an image for action classification of moving objects. The result shows the preprocessed image, identification of moving objects, corners detection and action classification of an image. Here, the evaluation measure is used to evaluate the performance of classifier. Here the performance analysis shows that the performance of proposed algorithm is increased when compared to existing classification algorithm.

Key-Words: *- Classification, SVM, Identification, Preprocessing, Corner detection, Performance.*

1. INTRODUCTION

Now days, mining of data and image are very important areas in research. The term mining refers to mining of useful information or knowledge from a large database, data warehouse or any other information repositories [13]. This process is called as data mining. Similarly, mining of useful information from an image is called as image mining. In real world most of the applications use the image mining technique such as image processing, cloud computing, disease diagnosis, pattern recognition, military applications, etc. Image mining has many techniques such as preprocessing, feature selection, corner detection, Classification, Clustering, Association Rule, Summarization and Regression. It also has two types of learning such as supervised and unsupervised learning [13].

This paper discusses about mining of images using feature selection and action classification [1] [2]. The camera images have noise, redundant image and sometimes low quality images. These unwanted elements should be eliminated from the images using image preprocessing. This preprocessing technique is very important for eliminating noise, redundant data, increasing the contrast of images and to find the missing values. It has many techniques such as cleaning, normalization, dimensionality reduction and transformation [14-18]. Corner detection is a method for selecting the interest points from the object or images. It is used in motion detection, image registration, object recognition and video tracking. Here, classification uses supervised learning technique and clustering uses unsupervised learning techniques. The classification is a technique to identify the test set objects belonging to training set [14]. The classification has the following algorithms such as Naive Bayes classification, Bayesian Belief Networks, Decision Tree and Nearest Neighbor Classification etc.

The association rule mining technique is used to find the similarity between dataset in large databases. It has the strong measures of support and confidence to find the relations between the patterns. The algorithms in association rule are Apriori algorithm, FP-Growth algorithm, ECLAT and OPCUS search algorithm [15]. Summarization is a technique for reducing the text documents. It uses the unsupervised learning techniques of TextRank and LexRank. Regression is a technique which is used to analysis the relationship between variables using statistical estimation. Clustering is an unsupervised technique for identifying the similar groups and structures in the data. It uses the Centroid based clustering, Hierarchical Based Clustering, Distribution Based Clustering and Density Based Clustering [15].

This paper describes the modified algorithm for Image Preprocessing, Corner detection, feature selection and using modified adaboost classification for action recognition. The rest of this paper discusses the literature review, Methodologies, Results and discussion, Evaluation measure, performance analysis and finally concluded with the conclusion.

2. RELATED WORKS

In object recognition the feature selection is very important technique to select the features of an image. Feature Selection using Linear Classifier Weights is used to feature scoring and selection based on weights from linear classification models [1]. A feature selection algorithm (FSA) is a computational solution that is motivated by a certain definition of relevance. The purpose of a FSA is to identify relevant features according to a definition of relevance [2].The field of action recognition has seen a large increase in activity in recent years. This action recognition using the 2D Harris corner detector for selecting the interest points in the image and it uses the association rule for recognizing the particular object [3]. Support Vector Machine (SVM) is an effective classification method, but it does not directly obtain the feature importance. This SVM is combined with many techniques to give better feature selection [4]. The feature selection of each SVM is done using the RBF kernel for estimating the scale parameter of RBF kernel. This is a problem of hyper

parameter estimation (or model selection) for SVMs, and is solved by minimizing the radius/margin (R/M) bound based on a gradient descent method [5]. In the classification of images, an important step is recognition of objects from the image. On the basis of the identified objects, we classified satellite images with the help of decision tree [6]. For discriminating the pose clusters, we use kernel Support Vector Machines (SVM) with pose-dependent feature selection. Each linear regression is capable of selecting relevant components of the feature vector depending on pose by training it on a pose cluster which is a subset of the training samples with similar pose [7].A dynamic Bayesian network model which combines RFID and video data to jointly infer the most likely activity and object labels [8]. The Contrast of images is increased using the modified sigmoid function [9]. We present a novel combination of standard activity classification, object recognition, and text mining to learn effective activity recognizers without ever explicitly labeling training videos [10]. To learn the action recognition problem 2D Harris Corner detector is used to detect the corner for particular object [11]. In classifiers the Adaboost classifier is used for classifying the action between the object [12]. The data mining techniques is having many algorithms for mining the data and images [13-18].

3. PROPOSED SYSTEM

This paper concentrates on image mining to classify the actions performed by the human. Here, the real time video images are used to detect object and recognize the action of the particular object. This paper proposes the modified sigmoid function with Gaussian filter for image preprocessing. This technique is used to improve the quality of image in all the features. The action classification is done by using the modified adaboost classifiers and the corner are detected using the 3D Harris corner detector. Here, the ada boost algorithm needs less tuning parameters for increasing the efficiency of classification technique. In this paper, the sigmoid function is used to control both contrast and brightness of the real time images. The Gaussian filter is mainly used to reducing the noise from the given blur image.

4. METHODOLOGIES

This section discusses about different methods and algorithms for image preprocessing, feature selection, corner detection and action recognition of object in the image. This paper concentrates into classification of action in the image. Normally, the classification technique using supervised learning. This supervised learning technique having two phases.

1. Training Phase
2. Testing phase

The classifier is trained based on the training data. The training data contains set of input values and associated output values. In training phase, the input data and the desired output data are continually submitted to the classifiers. In this paper the training phase contains following steps:

Step 1: Get the real time Image.

Step 2: Image pre processing technique is applied an image to remove the noise and improve the image quality.

Step 3: To identify the Moving objects using counter value .If the counter value is zero then the object is called as non moving object. Otherwise the object is called as moving object.

Step 4: Detect the corners of particular object.

Step 5: Store the Corners in database.

In testing phase, the classifier gets input data, processes it and produces the output based on the training of classifier. In this paper the testing phase contains following steps:

Step 1, 2, 3 and 4 are same as steps in training phase.

Step 5: Apply the classifiers to recognize actions in the object.

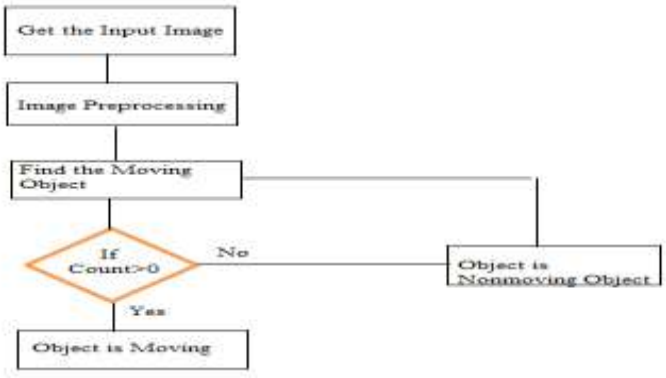


Fig 1. Flowchart for Finding Moving Object

4.1. Image Preprocessing

This paper gives the sigmoid function with Gaussian filter algorithm to produce pre-processed image. Commonly, the sigmoid function is used to improve the quality of images and normalization of images. The Gaussian filter is used to blur image and remove the noise in the image. Here, Figure 2 shows the flowchart for image preprocessing. The following steps are used to preprocess the input image.

Step 1: Get the Input Image.

Step 2: Apply the sigmoid function with Gaussian filter to preprocess the given image.

Step 3: Get the preprocessed Image.

4.1.1. Sigmoid Function with Gaussian Filter

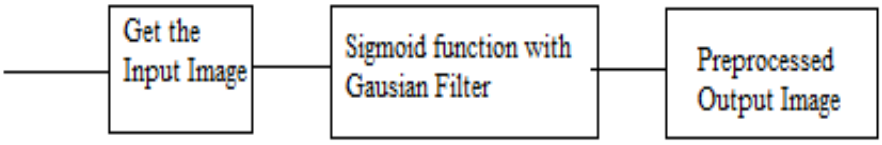


Fig.2. Steps for Image Preprocessing

This paper proposes the sigmoid function with Gaussian filter to preprocess the given image. A sigmoid function is an S shaped curve is also called as a sigmoid function. It refers to the logistic function with following formula:

$$S(t) = \frac{1}{1 + e^{-t}} \quad (1)$$

Here, the sigmoid function is combined with Gaussian filter to preprocess the particular image. In this technique, consider the three directional i, j, k to preprocess the particular image. This preprocessing technique is used to remove the noise, increasing the contrast of images and improve the quality of images. The following formula is used to preprocess the input image.

$$O(i,j,k) = f(i,j,k) + L1 * \frac{f(i,j,k)}{1 - \exp\left(L2 * L2 + f(i,j,k)\right)} + G_\sigma \quad (2)$$

In equation 2, L1and L2 is the parameters, which is used to control the brightness and contrast if the images. f (i, j, k) is the input image and G_σ is the Gaussian filter, which is used to remove the noise. The Gaussian filter, $G_{\sigma,}$ is represented as follows:

$$G_\sigma = \frac{1}{2\pi\sigma^2} \exp \frac{x^2 + y^2 + z^2}{2\sigma^2} \quad (3)$$

In equation 3, σ refers the standard deviation of the image. The value of x, y and z is calculated from the origin of the image.

4.2 Feature Selection

This paper introduces modified correlation feature selection algorithm for selecting the features. These selected features will be represented in the form of vector. It is also called as attribute selection or variable selection. Here, feature selection is mainly used to find the particular object in an image. The feature will be identified based on the feature vector. This vector can be represented in the form of matrix. Here 5X5 matrix is used to represent the feature vector. It is having the following steps:

Step 1: Get the preprocessed image.

Step 2: Find the Merit features from the image.

Step 3: Find the correlation feature selection using classification-feature relevance and feature-feature relevance.

Step 4: Identify the object based on the feature selection.

4.2.1 Modified Correlation Feature Selection

The Merit features are calculated using the following formula. The relevance is used for calculating the merit features of the particular object. Here, classification - feature relevance and feature – feature relevance are used for finding the relevance between the features. This is shown in equation 4:

$$\text{Merit (feature)} = \frac{k_{r_{ff}}}{\left(\sqrt{k + k(k+1)r_{cf}}\right)} \tag{4}$$

Where, k - It consists of set of 'k' features.

r_{ff} - It represents feature to feature relevance.

r_{cf} – It represents classification to feature relevance.

$$MCFS = \max\left[\frac{r_{cf1} + r_{cf2} + r_{cf3} + \cdots + r_{cfk}}{\left(\sqrt{k + l(r_{f1f2} + r_{f3f4} + r_{f5f6} + \cdots + r_{fifj} + \cdots + r_{fkf1})}\right)}\right] \tag{5}$$

Where, l is a constant. The value of l is represented as l=0, 1, 2, 3… n.

k - It consists of set of 'k' features.

r_{ff} - It represents feature to feature relevance.

r_{cf} – It represents classification to feature relevance.

4.3 Corner Detection

This technique is used to find the interest points in an image. It is a point, in which the well-defined position can be detected from an image. Here, the interest point in an image is called as corner. This paper gives modified 3D Harris corner detector for detecting the interest point in an image. These corners are used to identify the actions in the particular image.

The following steps are used to find the corners in an image:

Step 1: Get the Input Image.

Step 2: Apply 3D Harris Corner Detector for detecting the interest points in an image.

Step 3: Get the corners of a given image.

4.3.1 Modified 3d Harris Corner Detector

Here, the image intensity will change largely in image corner. This algorithm uses the three directions to find the corners of an image. The three directions are considered as x, y, and z. The following equation 6 shows the modified 3D Harris Corner Detector:

$$H(X) = w(x,y,z)\begin{bmatrix} I^2(x) & I_xI_y(X) & I_xI_yI_z(X) \\ I_yI_z(X) & I^2(y) & I_yI_xI_z(X) \\ I_zI_x(X) & I_zI_xI_y(X) & I^2(z) \end{bmatrix} \tag{6}$$

Where,

Ix, Iy, Iz – It represents the pixel intensity of an image.

W(x, y, z) – Weighting function.

The weighting function is represented in equation 7. This function uses the Gaussian distribution for calculating the weighting function.

$$w(x,y,z) = g(x,y,z,\sigma) = \frac{1}{2\pi\sigma^2}\left(\frac{x^2+y^2+z^2}{2\sigma^2}\right) \tag{7}$$

4.4 Classification

The SVM and Adaboost are the most used classifiers having good performance and more efficiency compared to other classifiers. This paper gives the adaboost classifiers for action classification. Normally, Adaboost classifiers are

having less tuning parameters compared to SVM. This tuning parameter is mainly used for improving the performance of classifiers. The figure 3 shows the steps involved in classification.

Step 1: Get the Input image.

Step 2: Identify the object based on the feature selection.

Step 3: Detect the corners of an image.

Step 4: Store the corners and actions to the database.

Step 5: Use the steps in testing phase and compare the corners in database.

Step 6: If the corners already exist, then give the actions related to that corners.

Step 7: If the Corners don't exist in the database, then store these new corners and actions to the database.

Modified Adaboost algorithms using the following steps:

1. Initialize the weights w_i^+, w_i^- .It will be represented as follows:
$W_i += \frac{1}{2N^+}$ and $W_i -= \frac{1}{2N^-}$. Here, i= 1, 2… N and –ve, +ve represent the samples for classification.
2. For m= 1 to M
Find the decision stump $h_m(x)$ to the training data using the weights w_i^+ and W_i^-.Here $h_m(x)$ is represented as follows:
$h_m(x)=sign(x_i+t_m)$ (8)
Where, $t_m$is a feature value is also called as threshold for the decision stump.
3. Compute the error $err_m = \frac{\sum_{i=1}^{N} w_i m I(yi \neq hm(x))}{\sum_{i=1}^{m} w_i m}$
4. Compute α_m. Where $\alpha_m = \ln\left(\frac{1-err_m}{err_m}\right)$
5. Combine weak learners into strong classifiers.
$f(x) = \sum_{i=1}^{m} \alpha_m h_m(x)$ (9)

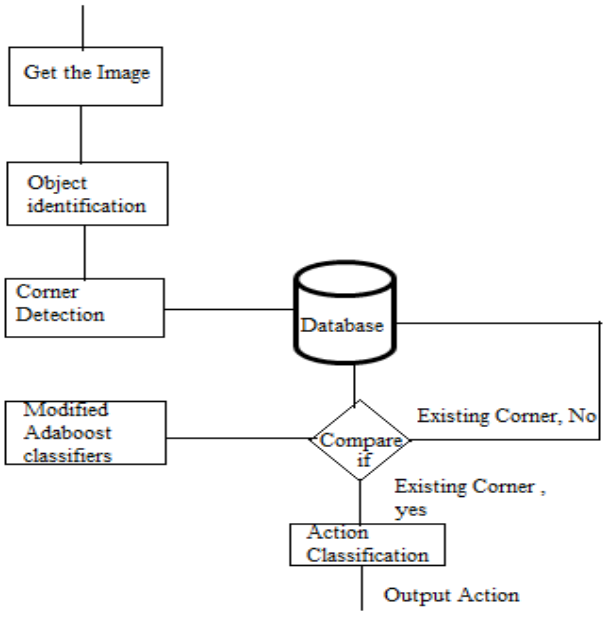


Fig 3. Steps for Classification

5. RESULTS AND DISCUSSION

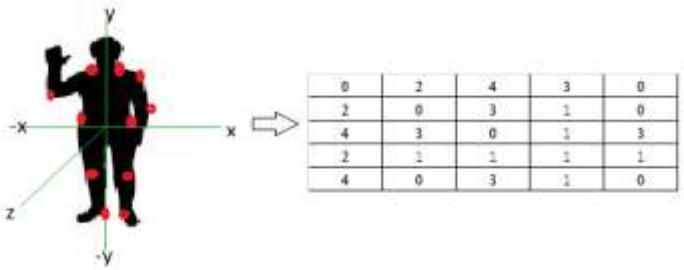
Figure 4 and 5 show the original image of training phase and preprocessed image using sigmoid function with Gaussian filter. Here the original image having noise and low quality images. This noise will be eliminated using the Gaussian filter and quality of image was increased using sigmoid function. Figure 6 and 7 show the feature selection of human using modified correlation feature selection and the corner of particular image was detected using the 3D Modified Harris corner detector. This corner detection is mainly used to recognize the action of particular image using adaboost classifier. Here the feature selection is done by using the feature of the image and matrix of feature selection. Figure 7 and 8 show the feature matrix for particular image. Then action was recognized for this image. In figure 9 having the action of

walking, hand waving and running. These actions will be trained and that particular output will be stored into the database. Based on this training phase the testing phase was implemented using the classification technique.

Fig 4. Original Image (Training Phase)

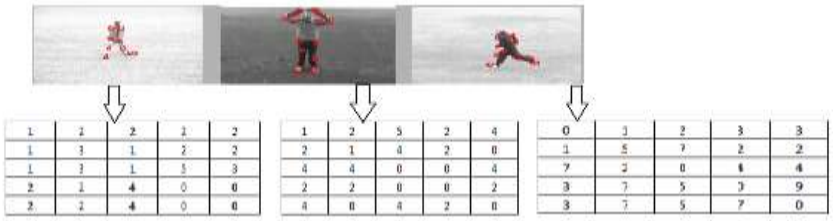
Fig5. Preprocessed Image (Training Phase)

Fig 6. Feature Selection for Human (Training Phase)



0	2	4	3	0
2	0	3	1	0
4	3	0	1	3
2	1	1	1	1
4	0	3	1	0

Fig 7. Matrix for Feature Selection



1	1	2	1	2
1	3	1	2	2
1	2	1	5	3
2	1	4	0	0
2	1	4	0	0

1	2	5	2	4
2	1	4	2	0
4	4	0	0	4
2	2	0	0	2
4	0	4	2	0

0	1	2	3	3
1	5	7	2	2
7	2	0	6	4
3	7	5	3	9
3	7	5	7	0

Fig 8. Matrix for Feature Selection

Fig 9. Corner Detection using 3D Modified Harris Corner Detector (Training Phase)

Fig 10. Original Image in Left Side and Preprocessed Image in Right Side (Testing Phase)

Figure 11, 12 and 13 show the output of preprocessed image, feature selection of the image, corner detection and action classification in the testing phase.

Fig 11. Object Identification Using Feature Selection (Testing Phase)

Here figure 16 shows the feature matrix for the selected picture in figure 15. It will be detected by using the modified correlation feature selection algorithm.

0	4	2	6	6
3	1	5	1	1
6	2	0	4	4
2	6	4	0	8
3	6	4	0	0

Fig 12. Matrix for Feature Selection

Adaboost Classifier (Testing Phase) Here, image preprocessing is done by using the sigmoid function with Gaussian filter. In this process the range of L1 and L2 is used to control the brightness and contrast of images.

Fig 13. Action classification using Modified

Here, brightness and contrast of the images are good when the L1 value and L2 value is taken as same. This result will be shown in table 1.

Table 1. Range of Brightness for L1 and L2

The parameter value L1,L2 for Brightness	L2=10	L2=9	L2=8	L2=7	L2=6	L2=5	L2=4	L2=3	L2=2	L2=1	L2=0
L1 =10	0.98	0.92	0.86	0.84	0.85	0.84	0.89	0.76	0.60	0.50	0.49
L1=9	0.97	0.97	0.86	0.82	0.74	0.65	0.56	0.49	0.58	0.49	0.46
L1 =8	0.92	0.92	0.95	0.82	0.71	0.74	0.62	0.51	0.62	0.36	0.32
L1=7	0.94	0.91	0.85	0.98	0.62	0.64	0.54	0.62	0.54	0.32	0.35
L1 =6	0.98	0.92	0.86	0.78	0.74	0.64	0.50	0.63	0.53	0.45	0.34
L1=5	0.93	0.90	0.86	0.79	0.84	0.94	0.45	0.64	0.61	0.32	0.45
L1 =4	0.92	0.91	0.87	0.81	0.84	0.75	0.93	0.60	0.52	0.25	0.34
L1=3	0.98	0.92	0.85	0.84	0.78	0.87	0.74	0.92	0.51	0.51	0.32
L1=2	0.97	0.93	0.87	0.74	0.85	0.82	0.76	0.85	0.96	0.41	0.31
L1=1	0.96	0.91	0.89	0.71	0.83	0.84	0.87	0.82	0.85	0.90	0.34
L1=0	0.95	0.89	0.87	0.72	0.89	0.83	0.82	0.81	0.87	0.78	0.88

6. EVALUATION MEASURE

Here the performance of classifiers is evaluated using the metrics of F-measure. The F-measure is a harmonic mean of precision and recall [19]. The equation 10 shows the calculation of F-measure.

$$\text{F} - \text{measure} = \frac{2 * (\text{Precision} * \text{Recall})}{\text{Precision} + \text{Recall}} \quad (10)$$

The following equation 11 and 12 shows the formula for precision and recall.

$$\text{Precision} = \frac{\text{TP}}{(\text{TP} + \text{FP})} \quad (11)$$

$$\text{Recall} = \frac{\text{TP}}{(\text{TP} + \text{FN})} \quad (12)$$

Where,
Precision – Percentage of positive predictions that are correct.
Recall - percentage of positive labelled instances that were predicted as positive.
TP – True Positive of the particular instances.
FP - False Positive of the particular instances.
FN - False Negative of the particular instances.

7. PERFORMANCE ANALYSIS

The table 2 shows the rate of precision and recall of adaboost and modified adaboost classification algorithm. Here the F-measure is calculated using precision and recall. The table 2 shows the increased performance of modified adaboost classifier. Figure 14 represents the increased performance of modified adaboost classifier compare to adaboost classifier.

Table 2. Rate of Precision, Recall and F-measure for the algorithm

Algorithm/ Measure	Precision	Recall	F-Measure
Adaboost Classifier	87%	81%	84%
Modified Adaboost Classifier	95%	94%	95%

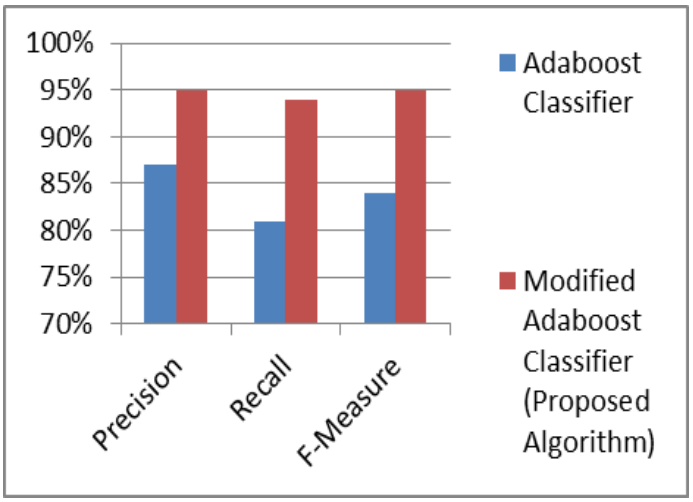


Fig 14. Performance Graph

8. CONCLUSION AND FUTURE ENHANCEMENT

Image mining plays a very important role in all areas of research. In real world many application are using this data mining techniques for mining the images. These mining techniques are mainly used in the military, disease diagnosis, terrorism attack and action recognition, etc. This paper concentrates on action recognition of images. In many of the researchers are using the SVM classification techniques for action classification. This paper proposed modified adaboost classifier for action classification. This technique needs the less tuning parameter compare to SVM for increasing the

performance of classifier. This action is recognized using the 3D Modified Harris detector. Here the proposed algorithm having the 11% of increased classification accuracy compare to existing algorithm. In future, the modified adaboost classifier is combined with filters for reducing the noise sensitivity of adaboost algorithm.

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